Appendix B
ENVIRONMENTAL IMPACT METHODOLOGY

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This appendix briefly describes the methods used to assess the potential direct, indirect, and cumulative effects of the alternatives in the Complex Transformation Supplemental Programmatic Environmental Impact Statement *(Complex Transformation SPEIS). Included are impact assessment methods for land use, visual resources, site infrastructure, air quality and noise, water resources, geology and soils, biological resources, cultural and archeological resources, socioeconomics, human health and safety, accidents, environmental justice, transportation, waste management, and cumulative impacts.*

B.1 LAND RESOURCES

B.1.1 Description of Affected Resources and Region of Influence (ROI)

The analysis of impacts to land use considers land use plans and policies, zoning regulations, and existing land use as appropriate for each site analyzed. The potential impacts associated with changes to land use as a result of the alternatives are also discussed.

B.1.2 Description of Impact Assessment

Land use changes associated with the implementation of the Complex Transformation SPEIS could potentially affect both developed and undeveloped land at each site. Potential changes in land use, if any, would likely occur within the existing boundaries of the alternative sites. However, the use of lands adjacent to or in the vicinity of U.S. Department of Energy (DOE) sites (i.e., non-DOE land) could be affected by these changes, including new or expanded safety zones.

Land use changes associated with construction and operation of new facilities could potentially affect both developed and undeveloped land. Land use impacts were assessed based on the extent and type of land that would be affected. The land use analysis also considers potential direct impacts resulting from the conversion of, or the incompatibility of, land use changes with special status lands such as national parks/monuments or prime farmland, and other protected lands such as Federal- and State-controlled lands (e.g., public land administered by the Bureau of Land Management (BLM) or other Government agencies). DOE did not consider the indirect land use impacts that could result from construction and operation of new facilities. In assessing impacts to land, the programmatic and project-specific methodologies were the same.

B.2 VISUAL RESOURCES

B.2.1 Description of Affected Resources and Region of Influence

Visual resources include natural and man-made physical features that give a particular landscape its character and value. The feature categories that form the overall impression a viewer receives of an area include landform, vegetation, water, color, adjacent scenery, rarity, and manmade (cultural) modifications.

B.2.2 Description of Impact Assessment

Criteria used in the visual resources analysis include scenic quality, visual sensitivity, distance, and/or visibility zones from key public viewpoints. The analysis is comparative in nature and consists of a qualitative examination of potential changes in visual resources, scenic values (attractiveness), and view corridors (visibility). Aspects of visual modification examined include site development or modification activities that could alter the visibility of structures at each of the alternative sites or obscure views of the surrounding landscape, and changes in land cover that could make structures more visible. In assessing impacts to visual resources, the programmatic and project-specific methodologies were the same.

B.3 SITE INFRASTRUCTURE

B.3.1 Description of Affected Resources and Region of Influence

Potentially affected site infrastructure resources include ground transportation systems, electrical distribution systems, fuels (primarily natural gas), and water. The ROI is considered to be all the land area and resources within the site boundary

B.3.2 Description of Impact Assessment

The assessment of potential impacts to site infrastructure focuses on the ability of the sites to support any of the facilities assessed in the SPEIS. The programmatic analysis focuses on supporting electrical power requirements. Other infrastructure demands, such as fuels or industrial gases, are not expected to be major discriminators for the programmatic alternatives analyzed in this SPEIS. The analysis addresses whether there is sufficient available and peak capacity to support Complex Transformation. Projections of electricity availability, site development plans, and other DOE mid- and long-range planning documents are used to project site infrastructure conditions. The project-specific analyses identify any significant infrastructure demands. In general, the infrastructure demands of all the project-specific alternatives would be minor compared to the existing infrastructure that exists at the sites analyzed.

B.4 AIR QUALITY AND NOISE

B.4.1 Nonradiological Air Resources

B.4.1.1 *Description of Affected Resources and Region of Influence*

The air quality assessment evaluates the consequences of criteria and hazardous/toxic air pollutants associated with each alternative at each candidate site. The criteria pollutants are specified in 40 *Code of Federal Regulation* (CFR) Part 50, the U.S. Environmental Protection Agency (EPA) Regulations on National Primary and Secondary Ambient Air Quality Standards (NPSAAQS). The hazardous/toxic air pollutants are listed in Title III of the 1990 *Clean Air Act* (CAA) Amendments, the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 61), and standards or guidelines proposed or adopted by the respective States.

Current information on emissions from existing operations and ambient air concentrations have been obtained for each alternative site (e.g., site annual reports, recent Environmental Impact Statements [EISs]).

B.4.1.2 *Description of Impact Assessment*

Industrial Source Complex Model 3 (ISC3) is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. This model can account for settling and dry deposition of particles; downwash; point, area, line, and volume sources; plume rise as a function of downwind distance; separation of point sources; and limited terrain adjustment. ISC3 operates in both long-term and short-term modes. The screening version of ISC3 is SCREEN3. The impacts of construction emissions are evaluated based on results of SCREEN3 dispersion model and Industrial Source Complex Short Term (ISCST) model. The SCREEN3 model estimates pollutant concentrations (in units of ug/m^3) as a function of distance from the source. EPA-approved conversions are applied to adjust the predicted concentrations for comparison to the ambient air quality standards (NRC 2005). Pollutant emissions that contribute to or cause a violation of air quality standards are considered to have a major impact. Mitigation measures are identified where appropriate.

For the programmatic alternatives, which have the potential to disturb significant land during construction, modeling was performed to determine if PM_{10} emissions (which were considered to be the most likely criteria pollutant to exceed regulatory limits) at the site boundary would exceed regulatory limits. Fugitive dust generated during the clearing, grading, and other earth-moving operations is dependent on a number of factors including silt and moisture content of the soil, wind speed, and area disturbed. Fugitive emissions were estimated based on the EPA emission factor of 1.20 tons per acre per month of activity (EPA 1995). This emission factor represents total suspended particulates (i.e., particles less than 30 microns in diameter). A multiplication factor of 0.75 was used to correct the emission rate to one for PM_{10} (EPA 1995). Also, it was assumed that water would be applied to disturbed areas. This would reduce emission rates by about 50 percent.

The impacts of nonradiological emissions from operations are evaluated based on results of the ISCST3 dispersion model. The predicted concentrations at the nearest site boundary are added to regional background concentrations for comparison with the ambient air quality standards to assess compliance. Additional qualitative evaluation is applied to describe potential adverse impacts for proposed sites that are located within 50 miles of a Federal Class I area. Pollutant emissions that contribute to or cause a violation of air quality standards are considered to have a major impact.

For the project-specific alternatives, increases in air emissions were compared to emissions from existing operations to determine if detailed modeling was necessary to demonstrate National Ambient Air Quality Standards (NAAQS) compliance. For minor increases and/or situations in which the ambient concentrations of pollutants are well below NAAQS standards, modeling was not necessary.

B.4.2 Radiological Air Resources

B.4.2.1 *Description of Affected Resources and Region of Influence*

Inhalation and ingestion are the two primary modes of exposure from radionuclide emissions. Inhalation occurs while the radionuclides are still airborne. The ROI for inhalation exposure is considered the DOE site boundary because Federal regulations limit the airborne dose exposures at the site boundary.

Radionuclide emissions will eventually settle back to the earth onto vegetation, soils, and waterbodies. Vegetation can then absorb radionuclides from the soils, and fish can absorb radionuclides from the water. When people and wildlife eat the plants or fish, they can potentially ingest radionuclides. Wildlife and waterbodies are generally not confined within the site boundary; therefore, ingestion impacts can extend to a larger region, but are generally bounded within 50 miles of the point of release.

Current information on dose to non-involved workers, maximally exposed individual (MEI), and collective dose to surrounding population due to radiological releases from existing operations has been obtained from each alternative site (e.g., site annual reports, recent EISs). Impacts from implementation of Complex Transformation programmatic alternatives were modeled at each potentially affected site using the CAP-88 computer model, version 3. The CAP-88 model was developed by EPA for assessments of both collective populations and MEIs.

B.4.2.2 *Description of Impact Assessment*

It is expected that radiological impacts from Complex Transformation to workers and surrounding population will be predominantly via the air pathway because no effluents are anticipated to be released. The impacts from implementation of Complex Transformation at each site are based on a combination of site-specific and technology-specific data. Site-specific data required for modeling include meteorology (e.g., wind speed, wind direction, precipitation), population distribution (for impacts on population), agricultural production (distribution about the release, types and quantity produced), and distances and directions to the fenceline (or other locations at which the public could be exposed; and for MEI calculations).

Operations data required for the calculations include release rates (i.e., curies per year by nuclide) and modes of release (e.g., stack height, stack velocity, diffuse release area). Doses have been calculated for the general population and for non-involved workers (i.e., onsite workers not directly involved in the pit manufacturing operations). Doses were converted to impacts as explained in Section B.11.2. For the project-specific tritium analysis, radiological emissions associated with tritium alternatives were used to estimate potential impacts based on comparisons to the impacts from other tritium emissions. There were no other radiological releases associated with other project-specific analyses.

B.4.3 Noise

B.4.3.1 *Description of Affected Resources and Region of Influence*

Current information on noise from existing operations has been obtained from each alternative site (e.g., site annual reports, recent EISs). Resources potentially affected by noise include wildlife and sensitive receptors in the vicinity of the project site. Construction noise levels would generally be higher than operation noise levels; therefore, the ROI is the radial area within 500–1,000 feet of the project site, depending on the specific conditions affected noise propagation that include topography and presence of large structures or dense vegetation.

B.4.3.2 *Description of Impact Assessment*

The methodology used to determine environmental impacts of Complex Transformation at each of the alternative sites with respect to noise involves a two-step analysis. The first step is to identify noise levels associated with implementation of Complex Transformation and determine if they are likely to exceed noise levels defining ambient background conditions. If these noise levels could exceed ambient conditions, the analysis determines whether the impacts are significant, using a qualitative assessment of the increase or decrease in noise level experienced by receptors near the source.

In the noise assessment, DOE included a description of the noise sources and noise levels anticipated for construction. Unmitigated logarithmic sound attenuation is assumed to estimate the distance needed for sound levels to achieve an acceptable level for both human and wildlife populations. It is anticipated that operational noise levels would be consistent with other noise sources at the site, and that they would not impose an appreciable change to the overall noise environment. In assessing noise impacts, the programmatic and project-specific methodologies were the same.

B.5 WATER RESOURCES

B.5.1 Surface Water

B.5.1.1 *Description of Affected Resources and Region of Influence*

Surface waters include rivers, streams, lakes, ponds, playas, and reservoirs. An inventory of surface water resources in the project ROI, a description of areas in the ROI currently using surface water, general flow characteristics, reservoirs, and an identification of classifications applicable to the surface water have been used to determine the affected environment at each alternative site. Emphasis has been placed on those waterbodies that have the potential to be impacted during the facility’s operations over the timeframe analyzed. Current wastewater treatment facilities and discharges have also been described in the baseline.

The affected environment descriptions for water quality of potentially affected receiving waters for each site have been developed by reviewing current monitoring data to identify parameters that exceed water quality criteria. Monitoring reports for discharges permitted under the National

Pollutant Discharge Elimination System (NPDES) program and state regulations have been examined for exceeding permit limits or requirements. In addition, surface water quality has been evaluated in terms of whether the water body supports the designated use assigned by the individual states under the *Clean Water Act* (CWA).

B.5.1.2 *Description of Impact Assessment*

The assessment of potential water quality impacts includes evaluation of the type (wastewater effluent), rate, and potential discharge constituents. Environmental consequences may result if: 1) The surface water flow rate is decreased to the point where the capacity of the receiving waterbody to assimilate discharges is noticeably diminished; 2) The proposed increases in discharge cannot comply with NPDES permit limits on flow rates; 3) The proposed increases in discharges contribute to receiving waters already identified as exceeding applicable surface water quality criteria; or 4) The proposed increases in effluent cannot comply with pretreatment limits on flow rates or specific constituent contributions without additional treatment. In addition, any expected increases in surface water runoff are discussed along with the potential impact to surface water features at each site.

B.5.2 Groundwater

B.5.2.1 *Description of Affected Resources and Region of Influence*

As part of the affected environment section of the SPEIS, groundwater is described in terms of the local aquifers' extent and yield, thickness, EPA classification, and recharge and discharge areas for each site. Areas in the ROI currently experiencing groundwater overdraft and related problems, and areas that have experienced large water table declines are described if applicable. Current potable and process water supplies and systems, water rights agreements, and water allocation of the site areas are also described. The latest environmental data, including maps, reports, and other literature, are used to the maximum extent possible to evaluate these conditions.

The affected groundwater quality at the site was evaluated by reviewing current monitoring data and identifying any parameters that exceed State water quality standards, drinking water standards, and DOE derived concentration guides for radionuclides in water. Parameters that exceed water quality criteria are further described and contaminant plumes delineated, where possible.

B.5.2.2 *Description of Impact Assessment*

An assessment of potential groundwater quality environmental consequences associated with pollutant discharges during facility modification and operation phases (e.g., process wastes and sanitary wastes) is examined for each site to determine if a direct input to groundwater could occur. The results of the groundwater quality projections are then discussed relative to Federal and State groundwater quality standards, effluent limitations, and safe drinking water standards to assess the acceptability of each alternative. Operation parameters from the alternatives with the potential to further degrade existing groundwater quality have been identified.

The potential effects to groundwater availability are assessed for each alternative at each candidate site by evaluating whether the proposed project: 1) Increases groundwater withdrawals in areas already experiencing overdraft and other related problems (e.g., land subsidence); 2) Potentially decreases groundwater levels causing a substantial depletion of the resource; 3) Water requirements exceed the allotment, water rights, or available supply limits, if present; or 4) Reduces or ceases the flow of one or more major springs. Suitable mitigation measures to reduce impacts are identified and discussed. In assessing impacts to water resources, the programmatic and project-specific methodologies were the same.

B.5.3 Floodplains

Floodplains include any lowlands that border a water body and encompass areas that may be covered by overflow during flood stages. As part of the affected environment discussion at each site, floodplains are identified from maps and environmental documents. Any potential facility location within a 100-year floodplain or a critical action in a 500-year floodplain is assessed for environmental consequence. The 500-year floodplain evaluation is of concern for activities determined to be critical actions for which even a slight chance of flooding would be intolerable. Appropriate mitigation measures are identified to minimize potential floodplain impacts. In assessing impacts to floodplains for both the programmatic and project-specific alternatives, if any potential facility were located in a 100-year or 500-year floodplain, this was identified.

B.6 GEOLOGY AND SOILS

B.6.1 Description of Affected Resources and Region of Influence

The analysis of geology and soils examines the ROI, or lands occupied by and immediately surrounding each alternative site. Information on the regional structural geology, stratigraphy, and soils have been collated and summarized.

In addition, the seismicity of the region surrounding each site is evaluated to provide a perspective on the probability of earthquakes in the area and their likely severity. This information is used to provide input to the evaluation of accidents due to natural phenomena.

B.6.2 Description of Impact Assessment

The proposed project areas at each site are evaluated for the amount of disturbance that may affect the geology and/or soils of the areas under study. These impacts may include, among others, potential erosion impacts and impacts to potential geologic economic resources. Impacts, if any, have been evaluated and a determination made as to severity. Possible mitigation has also been identified for adverse impacts. In assessing impacts to geology/soils, the programmatic and project-specific methodologies were the same.

B.7 BIOLOGICAL RESOURCES

B.7.1 Description of Affected Resources and Region of Influence

The affected biological resources may include both terrestrial and aquatic plants and animals. Subsets of these categories include threatened and endangered (T&E) species, and specific protected habitats, such as wetlands. Biological resources have been described within the ROI, which is defined by the lands occupied by and immediately surrounding each alternative site. In the case of T&E species, and other special interest species, biotic information includes species distribution within the county of each alternative site location. Biological data from earlier projects, wetlands surveys, and plant and animal inventories of the proposed sites were reviewed to identify the locations of plant and animal species and wetlands and to identify the impact from physical, chemical, or radiological stressors. Descriptions are at a summary level and focus within four categories: terrestrial resources, wetlands, aquatic resources, and T&E species.

B.7.2 Description of Impact Assessment

During construction, impacts to biotic resources, including terrestrial resources, wetlands, aquatic resources, and T&E species, may result from land-clearing activities, erosion and sedimentation, and human disturbance and noise. Operations may affect biotic resources as a result of changes in land use, emission of radionuclides, water withdrawal, wastewater discharge, and human disturbance and noise. In general, potential impacts have been assessed based on the degree to which various habitats or species could be affected by an alternative. Where appropriate, impacts have been evaluated with respect to Federal and State protection regulations and standards.

The analysis of impacts of Complex Transformation programmatic alternatives to biological resources were addressed at a level that was appropriate to allow for a comparison of alternatives using the best information available. In general, the programmatic analysis of impacts to biological resources presented in the Complex Transformation SPEIS is qualitative rather than quantitative. Quantitative analyses would be performed in follow-on site- and project-specific *National Environmental Policy Act* (NEPA) documentation. For the project-specific analyses, the analysis evaluated the amount of land disturbed, and if any critical habitats or special status species could be affected, these were identified.

B.7.2.1 *Terrestrial Resources*

Impacts of the Complex Transformation proposed alternatives on terrestrial plant communities have been evaluated by comparing data on site vegetation communities to proposed land requirements for construction and operation. The analysis of impacts to wildlife is based to a large extent on plant community loss or modification, which directly affects animal habitat. The loss of important or sensitive habitats and species is considered more important than the loss of regionally abundant habitats or species. Impacts on biotic resources from the release of radionuclides were not evaluated because there are no data to suggest that biotic resources are more adversely affected than humans.

B.7.2.2 *Wetlands*

The potential direct loss of wetlands resulting from implementation of Complex Transformation have been addressed in a way similar to the evaluation of impacts on terrestrial plant communities; that is, by comparing data on site or area wetlands to proposed land requirements. Sedimentation impacts have been evaluated based on the proximity of wetlands to Complex Transformation project areas. Impacts resulting from wastewater discharge and other transport pathways (e.g. spills) into a wetland system have been evaluated, recognizing that effluents would be required to meet applicable Federal and State standards. In assessing impacts to wetlands, the programmatic and project-specific analyses identified whether any wetlands would likely be affected by new facilities.

B.7.2.3 *Aquatic Resources*

Impacts to aquatic resources resulting from sedimentation and wastewater discharge have been evaluated as described for wetlands. Potential impacts from radionuclides have not been addressed for the same reasons described for terrestrial resources.

B.7.2.4 *Threatened and Endangered Species*

Impacts on T&E species and other special interest species have been determined in a manner similar to that used to describe terrestrial and aquatic resources since the sources of potential impacts are similar. A list of species potentially present on each candidate site or in proximity to the candidate site or area has been developed using information obtained from the U.S. Fish and Wildlife Service (USFWS) and appropriate State agencies' databases. This list, along with consideration of site environmental and engineering data, and provisions of the *Endangered Species Act*, have been used to evaluate whether the various Complex Transformation siting alternatives could impact any threatened or endangered plant or animal (or its habitat). In assessing impacts to T&E species, the programmatic and project-specific analyses identified whether any T&E species would likely to be affected by new facilities.

B.8 CULTURAL AND ARCHEOLOGICAL RESOURCES

B.8.1 Description of Affected Resources and Region of Influence

Cultural resources are those aspects of the physical environment that relate to human culture and society, and those cultural institutions that hold communities together and link them to their surroundings. For this SPEIS, cultural resources are divided into three general categories: archeological resources, historic resources, and Native American resources. A cultural resource can fall into more than one of these categories due to use through a long period of time or multiple functions.

Archeological resources mean any material remains of past human life or activities which are of archeological interest (Public Law 96-95; 16 USC 470aa-mm). By definition, these resources predate written records. Historic resources include the material remains and landscape alterations that have occurred since the arrival of Europeans to the area. Due to the focus of this SPEIS on DOE facilities, historic resources often include resources associated with the Manhattan Project, World War II, and the Cold War. Native American resources are material remains, locations, and natural materials important to Native Americans for traditional religious or heritage reasons (Public Law 101-601). These resources are rooted in the community's history or are important in maintaining cultural identity.

The ROI includes the area within which cultural and archeological resources could be physically impacted by construction and operation activities include the area in and around the footprint of the proposed facilities. The ROI for all alternatives also includes cultural resources nearby that could have their historic settings adversely affected by the introduction of the new facility into the viewshed.

B.8.2 Description of Impact Assessment

The analyses of potential impacts to cultural and archeological resources are very similar because the two types of resources can be affected by the alternatives in much the same manner. The analyses address potential direct and indirect impacts at each candidate site from construction activities and operation of the facility. Most potential impacts are those resulting from groundbreaking activities; however, other types of impacts are considered, such as reduced access by practitioners to resources, introduction of visual, audible, or atmospheric elements out of character with the resources, and increased visitation to sensitive areas. Analyses of impacts take into consideration the location of the reference site, the acreage required for the proposed facility, and the likelihood of resources being located in that area. In assessing potential impacts to cultural and archeological resources, the programmatic and project-specific methodologies were the same.

B.9 SOCIOECONOMICS

The analysis of socioeconomics describes impacts on local and regional socioeconomic conditions and factors including employment, economy, population, housing, and community services at each alternative site considered in the Complex Transformation SPEIS. The potential for socioeconomic impacts is greatest in those local jurisdictions immediately adjacent to each site. Therefore, potential socioeconomic impacts are assessed using a geographic ROI. ROIs are used to assess potential effects on the economy as well as effects that are more localized in political jurisdictions surrounding the sites.

For each site, socioeconomic impacts were estimated using two geographic areas. First, an ROI was identified based on the distribution of residences for current DOE and contractor employees. The ROI is defined as those counties where approximately 90 percent of the current DOE and contractor employees reside. The ROI for each candidate site is presented in Table B.9-1. This residential distribution reflects existing commuting patterns and attractiveness of area communities for people employed at each site and is used to estimate the future distribution of direct workers associated with the each alternative. The evaluation of impacts is based on the degree to which change in population affects the housing market and community services.

The ROI for each site encompasses an area that involves trade among and between regional industrial and service sectors. It is characterized by strong economic linkages between the communities located in the region. These linkages determine the nature and magnitude of multiplier effects on economic activity (i.e., purchases, earnings, and employment) at each candidate site. Demographic characteristics included in the socioeconomic analysis within the ROI include population, housing, and community services.

The U.S. Bureau of Economic Analysis measures multiplier effects of interindustry linkages with the Regional Input-Output Modeling System (RIMS II). RIMS II is based on an accounting framework called an input-output table. An input-output table shows, for each industry, industrial distributions of input purchased and outputs sold. RIMS II Total Direct-Effect Multipliers has been used in the Complex Transformation SPEIS to estimate additional regional employment and income generated by employment and income directly associated with the Proposed Action. In assessing potential impacts to socioeconomics for the project-specific alternatives, the analysis focused on identifying jobs lost or added and compared these changes to the baseline. For the flight testing alternatives that would cease operations at the Tonopah Test Range (TTR), a more detailed socioeconomic analysis was performed, due to the potential to cause more significant impacts. That specific methodology is described in Section 5.15.4.2.1.

Table B.9-1—Candidate Sites' Region of Influence

LANL	LLNL	NTS	TTR	Pantex	SNL	WSMR	SRS	Y-12
New Mexico	**California**	**Nevada**	**Nevada**	**Texas**	**New Mexico**	**New Mexico**	**Georgia**	**Tennessee**
Los Alamos	Alameda	Clark	Esmeralda	Armstrong	Bernalillo	Dona Ana	Columbia	Anderson
Rio Arriba	Contra Costa	Nye	Nye	Carson	Sandoval	Lincoln	Richmond	Knox
Santa Fe	San Joaquin	Lincoln	Lincoln	Potter	Torrance	Otero	**South Carolina**	Loudon
	Stanislaus			Randall	Valencia	Sierra Socorro	Aiken Barnwell	Roane

B.10 ENVIRONMENTAL JUSTICE

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, signed by President William J. Clinton in February 1994, requires each Federal agency to formulate a strategy for addressing environmental issues in human health and environment related programs, policies, planning and public participation processes, enforcement, and rulemaking. The White House memorandum accompanying the Executive Order directs Federal agencies to "analyze the environmental effects…of Federal actions, including effects on minority communities and low income communities when such analysis is required by NEPA."

Any disproportionately high and adverse human health effects on minority populations or low-income populations that could result from Complex Transformation at any of the proposed alternative sites have been analyzed. The minority population and low-income population composition of the area surrounding the proposed alternative sites will be compared to that of a larger geographic area to determine whether possible impacts of siting Complex Transformation at a particular site will have a disproportionately high and adverse impact on minority or low-income populations. In assessing potential environmental justice impacts, the programmatic and project-specific methodologies were the same. As a first step, the analysis focused on whether there would be any high and adverse human health effects. If none were determined, then there was no need to determine if these high and adverse human health effects were disproportionate. For this PEIS, none of the health effects were determined to be both high and adverse.

B.11 HEALTH AND SAFETY

Potential impacts of construction and operation of facilities on public and worker health and safety include cancer fatalities resulting from exposure to radionuclides, and occupational injuries and illnesses resulting from facility construction and operation. Included in this appendix is a brief discussion of the methodology for analysis of impacts to public and worker health and safety.

B.11.1 Description of Affected Resources and Region of Influence

Potential impacts to human health and safety posed by Complex Transformation include radiological and nonradiological exposure pathways and occupational injuries, illnesses, and fatalities resulting from construction activities and normal (accident-free) operations of the completed facility. Exposure pathways include inhalation, immersion, ingestion, and exposure to external sources. Occupational regions of influence include involved and uninvolved workers. Nonoccupational ROIs for the public include the MEI and the general population surrounding the candidate sites.

Because NNSA operations have the potential to release measurable quantities of radionuclides to the environment that result in exposure to the worker and the public, NNSA conducts environmental surveillance and monitoring activities at its sites. These activities provide data that are used to evaluate radiation exposures that contribute doses to the public. Each year, environmental data from the NNSA sites are collected and analyzed. The results of these environmental monitoring activities are summarized in an Annual Site Environmental Report (ASER). The environmental monitoring conducted at most NNSA sites consists of two major activities: effluent monitoring and environmental surveillance.

Effluent monitoring involves the collection and analysis of samples or measurements of liquid (waterborne) and gaseous (airborne) effluents prior to release into the environment. These analytical data provide the basis for the evaluation and official reporting of contaminants, assessment of radiation and chemical exposures to the public, and demonstration of compliance with applicable standards and permit requirements.

Environmental surveillance data provide a direct measurement of contaminants in air, water, groundwater, soil, food, biota, and other media subsequent to effluent release into the environment. These data verify the NNSA site's compliance status and, combined with data from effluent monitoring, allow the determination of chemical and radiation dose and exposure assessment of NNSA operations and effects, if any, on the local environment. The effluent and environmental surveillance data presented in the ASERs were used as the primary source of data for the analysis of radiation exposure to the public for the No Action Alternative.

The public health consequences of radionuclides released to the atmosphere from normal operations at NNSA sites are characterized and calculated in the applicable ASER. Radiation doses are calculated for the MEI and the entire population residing within 50 miles of the center of the site. In this SPEIS, dose calculations from normal operations were made using the CAP-88 package of computer codes, version 3 (EPA 2008), which was developed under EPA sponsorship to demonstrate compliance with 40 CFR Part 61, Subpart H, which governs the emissions of radionuclides other than radon from DOE facilities. This package implements a steady-state Gaussian plume atmospheric dispersion model to calculate concentrations of radionuclides in the air and on the ground and uses Regulatory Guide 1.109 (NRC 1977) food-chain models to calculate radionuclide concentrations in foodstuffs (vegetables, meat, and milk) and subsequent intakes by humans.

Meteorological data used in the calculations were in the form of joint frequency distributions of wind direction, wind speed class, and atmospheric stability category. For occupants of residences, the dose calculations assume that the occupant remained at home (actually, unprotected outside the house) during the entire year and obtained food according to the rural pattern defined in the NESHAP background documents (EPA 1989). This pattern specifies that 70 percent of the vegetables and produce, 44.2 percent of the meat, and 39.9 percent of the milk consumed are produced in the local area (e.g., a home garden). The remaining portion of each food is assumed to be produced within 50 miles of the site. The same assumptions are used for occupants of businesses, but the resulting doses are divided by two to compensate for the fact that businesses are occupied for less than one-half a year, and that less than one-half of a worker's food intake occurs at work. For collective effective dose equivalent (EDE) estimates, production of beef, milk, and crops within 50 miles of the site was calculated using production rates provided with CAP-88.

B.11.2 Description of Impact Assessment

Radiological impacts have been assessed for workers (both involved and non-involved in Complex Transformation operations) and for the public (MEI and population). Health impacts to involved workers from Complex Transformation operations are based on information from the Complex Transformation alternative data report [NNSA 2007]. NNSA converted radiological doses to health effects (latent cancer fatalities [LCF]) using a multiplier of 600 fatal cancers per 10^6 person-rem based on "Radiation Risk Estimation from Total Effective Dose Equivalents (TEDEs)," (Office of Environmental Policy and Guidance, Washington, DC. August 9.) Similarly, health impacts to the MEI and population are based on doses calculated by the radiological air analyses. Continuous exposure over the year is assumed. For worker exposures, impacts were estimated based on estimates of the number of radiation workers and the average radiological dose, based on information from the Complex Transformation alternative data report [NNSA 2007]. In assessing potential human health impacts, the programmatic and project-specific methodologies were the same.

B.11.3 Occupational Safety

Occupational injury, illness, and fatality estimates are evaluated using occupational incidence rates of major industry groups, DOE, and DOE contractors. When site-specific evaluations are performed, DOE Computerized Accident/Incident Reporting System (CAIRS) data is used. Since activities similar to Complex Transformation operations or facility construction are not being performed at all of the potential Complex Transformation sites, U.S. Department of Labor, Bureau of Labor Statistics (BLS) injury, illness and fatality information for similar activities have been used. These rates are compared to person-hour estimates for the project. Occupational injury, illness, and fatality categories used in this analysis are in accordance with Occupational Safety and Health Administration (OSHA) definitions. Incident rates were developed for facility construction and facility operations.

Facility operations were evaluated to determine if any chemical-related health impacts would be associated with normal (accident-free) operations. Initial screens for the hazard analysis did not result in the identification of any controls necessary to protect the public or workers from direct chemical exposures. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection is augmented by facility safety programs such as Integrated Safety Management System (ISMS), work planning, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness. In assessing potential human health impacts, the programmatic and project-specific methodologies were the same.

B.12 ACCIDENT ANALYSIS

B.12.1 Description of Affected Resources and Region of Influence

Potential impacts to human health and safety from postulated accidents include radiological and nonradiological exposures. For both radiological and chemical accidents associated with operations, the affected resources are the facility and site workers and the offsite population. Specifically, for radiological accidents, the impact is incremental adverse health effects (i.e., LCFs) for a noninvolved worker, the offsite MEI, and the offsite population within 50 miles of each alternative site. For nonradiological accidents, airborne concentrations and potential health effects have been calculated for the noninvolved worker and the offsite MEI.

B.12.2 Description of Impact Assessment

Postulated accidents can be initiated by internal operations (e.g., fire, spill, criticality), external events (e.g., airplane crash), or natural phenomena (e.g., earthquake, flood). The Complex Transformation SPEIS evaluates unmitigated accident scenarios chosen to reflect the range and kinds of accidents that are postulated. The range of accidents is from low frequency high consequence events (probabilities as low as approximately 10^{-6}) to high frequency-low consequence events (probabilities as high as approximately 10^{-2}) in order to assess potential risks. The spectrum of accidents and their calculated impacts should provide a baseline for each site that can be used to judge the environmental implications of locating particular facilities and missions at different sites. The accident analyses were performed in accordance with the *Recommendations for Analyzing Accidents Under the National Environmental Policy Act* (DOE 2002b). Appendix C provides additional information on the accident methodology.

For radiological accidents, point estimates of radiation dose and, for the offsite population, corresponding incremental LCFs were calculated for a hypothetical noninvolved worker from release points at proposed sites, the offsite MEI, and the offsite population within 50 miles of each alternative site. For nonradiological accidents, estimates of airborne concentrations of chemical substances have been calculated for a hypothetical noninvolved worker and the offsite MEI.

It should be noted that the purpose of this SPEIS is to assist NNSA in making site selection decisions. Since nuclear weapons activities or facilities would be the same regardless of location, the risk to involved workers is independent of where the activity occurs or the facility is located and would not be a discriminating factor for programmatic siting decisions. For the project-specific analyses, potential impacts to involved workers were considered and discussed as appropriate.

For radiological and chemical accidents, the following general analytical steps were followed:

1. Screen operations at the facilities to identify those with the potential to contribute to offsite risk.
2. Identify and screen postulated accident scenarios associated with those operations.
3. Calculate source terms (release rates and frequencies) for these unmitigated scenarios assuming no mitigation of releases or frequencies.
4. Calculate onsite and offsite consequences (impacts to the health and safety of workers and the general public) of these scenarios.

The unmitigated consequences of accidental releases of radioactivity were calculated using the MELCOR Accident Consequence Code System Version 2 (MACCS2) with the radiological source term values described above. In addition to the source term data, the following input data for the MACCS2 code were obtained:

- Estimated location of specific facilities and their distance from the site boundary;
- Release heights (i.e., stack release, building release, or ground level release);
- Local meteorological conditions;
- Offsite population distribution (using the 2000 census data); and
- Offsite agricultural and economic data.

The consequences of accidental releases of hazardous chemicals were calculated using the Aerial Location of Hazardous Atmospheres (ALOHA) code based on information from the Complex Transformation alternative data report [NNSA 2007]. In addition to the source term data, input data for the ALOHA code is similar to that required for the radiological accident analysis, with the exception that offsite agricultural and economic data are not required.

For accident scenarios involving multiple operations within nuclear weapons facilities, such as those that might be caused by natural phenomena, estimates of radiation dose and corresponding incremental LCFs and estimates of airborne concentrations of chemical substances were calculated for the same receptors as described previously.

B.12.3 Terrorist Attacks

Analyses of the potential impacts of terrorist attacks are in a classified appendix to this SPEIS. The impacts of some terrorist attacks would be similar to the accident impacts described earlier in this section, while others would have more severe impacts. This section describes the methodology NNSA uses to assess the vulnerability of its sites to terrorist attacks and then designs its systems to prevent and deter those threats.

B.12.3.1 *Assessment of Vulnerability to Terrorist Threats*

In accordance with DOE Order 470.3A, Design Basis Threat Policy, and DOE Order 470.4, Safeguards and Security Program, NNSA conducts vulnerability assessments and risk analyses of its facilities and sites to determine the physical protection elements, technologies, and administrative controls NNSA should use to protect its assets, its workers, and the public. DOE Order 470.4 establishes the roles and responsibilities for the conduct of DOE's Safeguards and Security Program. DOE Order 470.3A establishes requirements designed to prevent unauthorized access, theft, diversion, or sabotage of nuclear weapons, components, and special nuclear material controlled by NNSA.

Among other things, DOE Order 470.3A: 1) Specifies those national security assets that require protection; 2) Outlines threat considerations for safeguards and security programs to provide a basis for planning, designing, and constructing new facilities; and 3) Requires the development of credible scenarios of threats that are used to design and test safeguards and security systems. NNSA must also protect against espionage, sabotage, and theft of materials, classified matter, and critical technologies.

NNSA's safeguards and security programs and systems employ state-of-the-art technologies to:

- Deny adversaries access to nuclear weapons, nuclear test devices, and completed nuclear assemblies;
- Deny adversaries the opportunity to steal special nuclear materials (SNM), sabotage weapons or facilities, or produce an unauthorized nuclear yield (criticality) of SNM;
- Protect the public and employees from harm resulting from an adversary's use of radiological, chemical, or biological materials; and
- Protect classified information, classified matter, and designated critical facilities or activities from sabotage, espionage, and theft.

NNSA's vulnerability assessments employ a rigorous methodology based on guidance from the DOE Vulnerability Assessment Process Guide (September 2004), and the Vulnerability Assessment Certification course. Typically, a vulnerability assessment involves analyses by subject matter experts to determine the effectiveness of a safeguard and security system used to protect against an adversary with certain capabilities. Vulnerability assessments generally include the following activities:

Characterizing the threat. Threat characterization provides a detailed description of a physical threat by a malevolent adversary to a site's physical protection systems. Usually the description includes information about the types of potential adversaries, their motivations, objectives, actions, capabilities, and site-specific tactical considerations. Much of the information required to develop a threat characterization is described in DOE Order 470.3A and the Adversary Capabilities List. The Department also issues site-specific guidance, to assist in this process.

Determining the target. Target determination involves identifying, describing, and prioritizing potential targets among NNSA's security interests. Results of target determinations are used to help characterize potential threats and objectives, as well as, protective force and neutralization requirements.

Defining the scope. The scope of a vulnerability assessment is determined by subject matter experts and depends on the site vulnerabilities. In addition to defining the threat and possible terrorist objectives, the scope establishes the key assumptions and interpretations that will guide the analyses, as well as the objectives, methods, and format for documenting the results of the vulnerability assessment.

Characterizing the facility or site. This activity requires defining and documenting every aspect of the facility or site to be assessed, particularly existing security programs (personnel security, information security, physical security, material control and accountability, etc.), to assist in identifying strengths and weaknesses. Results are used as inputs to the pathway analyses, which DOE uses to develop representative scenarios for evaluating the security system. Facility and site characterization modeling tools include Analytical System and Software for Evaluating Safeguards and Security (ASSESS), Adversary Time-Line Analysis System (ATLAS), VISA, tabletop analysis, and others.

Characterizing the protective force. To assess a facility or site's vulnerability, analysts must accurately characterize protective force's capabilities against a defined threat and objective, particularly its ability to detect, assess, interrupt, and neutralize an adversary. Specific data used for this activity include special nuclear materials categorization; configuration, flow, and movement of special nuclear materials within or from a facility or site; defined threats; detection and assessment times; and adversary delay and task time. The protective force's equipment, weapons, size, and posts also are considered in the characterization. The characterization information is validated and verified via observation, alarm response assessments, performance tests, force-on-force exercises, joint conflict and tactical simulation (JCATS), and tabletop analyses. The JCATS software tool is used for training, analysis, planning, and mission rehearsal, as well as characterization of the protective force. It employs detailed graphics and models of buildings, natural terrain features, and roads to simulate realistic operations in urban and rural environments.

Analyzing adversary pathways. This activity identifies and analyzes adversary pathways based on the results of threat, target, facility, and protective force characterization, as well as ancillary analyses such as explosives analysis. ASSESS and ATLAS are two primary tools that are used in this analysis. Analysts also conduct insider analysis as part of this activity.

Developing credible scenarios. Credible scenarios are developed for use in performance testing and to determine the effectiveness of the security system in place against a potential adversary's objectives. As part of this activity, data from the adversary pathways analyses are used to identify applicable threats, threat strategies, and objectives, and combined with protective force strategies and capabilities to develop scenarios that include specific adversary resources, capabilities, and projected task times to successfully achieve their objectives. Specialists also work with the vulnerability assessment team to develop realistic scenarios that provide a structured and informal analysis of the strengths and weaknesses of potential adversaries.

Determining the probability of neutralization. The probability of neutralization is the probability that a protective force can prevent an adversary from achieving its objectives. The probability is derived from more than one source, one of which must be based on Joint Tactical Simulation, JCATS analysis, or force-on-force exercises.

Determining system effectiveness. System effectiveness is determined by applying an equation that reflects the capabilities of a multi-layered protection system. Analysis data derived from the various vulnerability assessment activities are used to calculate this equation, which reflects the security system's effectiveness against each of the scenarios developed for the vulnerability assessment. If system effectiveness is unacceptable for a scenario, the root cause of the weakness must be analyzed and security upgrades must be identified. The scenarios are reanalyzed with the upgrades, and effective upgrades are documented in the vulnerability analysis report.

Implementation. The culmination of the vulnerability assessment is development of a report documenting the analyses and results and a plan for implementing any necessary changes to security systems. NNSA verifies the results of the vulnerability assessment report and the conclusions of the implementation plan. NNSA also oversees the implementation of security system upgrades.

B.12.3.2 *Terrorist Impacts Analysis*

Substantive details of the credible scenarios for terrorist attacks NNSA's countermeasures, and potential impacts of attacks are not released to the public because disclosure of this information could be exploited by terrorists and assist them in the planning of attacks. Depending on the intentionally destructive acts, impacts may be similar to or would exceed those of bounding accidents analyzed elsewhere in the SPEIS. A separate classified appendix to this SPEIS evaluates the impacts of an adversary achieving its objectives in one or more of the credible scenarios.

The classified appendix evaluates the potential impacts of the successful execution of credible scenarios for the alternatives at seven sites (LANL TA-16, LANL TA-55, LLNL, NTS, SRS, Pantex, and Y-12) and calculates consequences to a noninvolved worker, maximally exposed individual, and population in terms of direct effects, radiation dose, and LCFs. Risks are not calculated because the probability that an adversary could successfully execute the attack in a scenario cannot be quantified. The MACCS2 and RISKIND computer codes are used along with other manual methods to calculate human health effects of each credible scenario. The same site-specific meteorology and population distribution that is used in the accident analyses in SPEIS Appendix C are used in analyses of the impacts of an adversary achieving its objectives in the credible attack scenario.

B.12.3.3 *Mitigation of Impacts from Potential Terrorist Attacks*

The DOE strategy for the mitigation of environmental impacts resulting from a terrorist attack has three distinct components: 1) Prevent and deter terrorists form executing successful attacks; 2) Plan and provide timely and adequate response to emergency situations; and 3) Progressive recovery through long-term response in the form of monitoring, remediation, and support for affected communities and their environment.

B.12.3.3.1 Actions to Prevent or Reduce the Probability of Successful Attacks

NNSA employs a well-established system of engineered and administrative controls to prevent or reduce the probability of occurrence of extreme events and to limit their potential impacts on the environment. This system has evolved over time and will continue to evolve as new security requirements are identified, as new become available, and as new engineering standards or best practices are developed. The directing requirements and the framework for implementing this system of controls are embodied in the Code of Federal Regulations and in DOE Orders. These are imposed as contractual requirements for DOE management and operating (M&O) contractors. The NNSA system of safety requirements and quality assurance guidelines and controls covers all aspects of key nuclear and non-nuclear facilities including design requirements, construction practices, start-up and operational readiness reviews, and routine operations and maintenance. The contractor and federal staff at these facilities are evaluated for trustworthiness and reliability.

B.12.3.3.2 Plan for and Respond to Emergency Situations

While NNSA has comprehensive security measures to prevent terrorist attacks, it is also necessary to have the capability for timely and adequate response to emergency situations. Therefore, in addition to the systems of workplace hazard controls and safeguards and security measures, the NNSA emergency management system imposes additional protections over operations involving dispersible hazardous materials in quantities that could harm people outside the immediate workplace. NNSA's comprehensive all-hazards approach to emergency management is established in DOE Order 151.1C, Comprehensive Emergency Management System. This Order provides a general structure and framework for responding to any emergency at an NNSA facility or for an NNSA activity and specific requirements to address protection of workers, the public, and the environment from the release of hazardous materials.

NNSA's comprehensive emergency management system is based on a three-tiered structure consisting of facility, site, or activity management; the Cognizant Field Element; and Headquarters, with each tier having specific roles and responsibilities during an emergency. Each organizational tier provides management, direction, and support of emergency response activities. Management personnel of a facility, site, or activity manage the tactical response to the emergency by directing the mitigative actions necessary to resolve the problem, protect the workforce, the public, and the environment; and return the facility, site, or activity to a safe condition. The Cognizant Field Element oversees the facility/site response and provides local assistance, guidance, and operational direction to the facility/site management. The Cognizant Field Element also coordinates the tactical response to the event with tribal, state, and local governments. NNSA Headquarters provides strategic direction to the response, provides assistance and guidance to the Cognizant Field Element, and evaluates the broad impacts of the emergency on the NNSA complex. Headquarters also coordinates with other Federal agencies on a national level, provides information to representatives of the executive and legislative branches of the Federal government, and responds to inquiries from the national media.

Each NNSA facility, site, or activity is required by DOE Order 151.1C to have an Operational Emergency Base Program, which provides the framework for responding to serious events or conditions that involve the health and safety of the workforce and the public, the environment, and safeguards and security. The objective of the Operational Emergency Base Program is to achieve an effective integration of emergency planning and preparedness requirements into an emergency management program that provides capabilities for all emergency responses through communication, coordination, and an efficient and effective use of resources, that is commensurate with the hazards present at that facility, site, or activity.

DOE Order 151.C requires that a Hazards Survey be prepared, maintained, and used for emergency planning purposes. The Order requires that emergency management efforts begin with the identification and qualitative assessment of the facility- or site-specific hazards and the associated emergency conditions that may require response, and that the scope and extent of emergency planning and preparedness reflect these facility-specific hazards. Hazards Surveys are used to:

- identify the generic emergency conditions that apply to each facility;
- qualitatively describe the potential health, safety, or environmental impacts of the applicable emergencies;
- identify the applicable planning and preparedness requirements; and
- indicate the need for further evaluation of hazardous materials in an Emergency Planning Hazards Assessment (EPHA).

Some facilities have been analyzed as stand-alone facilities; however, several structures or component units with common or related purposes have been combined into a facility- or complex-wide hazards survey. Each facility- or complex-specific hazards survey clearly identifies the facility and describes the facility's mission, operations, and physical characteristics.

Using the knowledge and insights gained through the Hazards Survey and EPHA processes, the emergency management organization at each NNSA site or facility develops detailed plans and procedures and trains the staff to carry out response actions to reduce the severity of hazardous material release events and to minimize health impacts.

The Response Activities of the Emergency Management Program that would come into play should an operational emergency occur would include many of the following elements, depending on the specific circumstances:

Emergency Response Organization (ERO). The ERO is structured to enable it to assume overall responsibility for initial and ongoing site actions associated with the emergency response and mitigation. The ERO establishes effective control at the event/incident scene and integrates local agencies and organizations providing onsite response services.

Offsite response interfaces. DOE Order 151.1C requires coordination with tribal, state, and local agencies and organizations responsible for offsite emergency response. Interrelationships and interfaces for fire, HAZMET, medical, and law enforcement and mutual assistance and support are pre-arranged and documented in various formal plans, agreements, and memoranda of understanding.

Emergency facilities and equipment. The EPHA is used to assist in determining the types and amounts of personal protective equipment, radiation monitoring, communications, and other equipment and supplies required to be maintained and operable for immediate use in responding to an operational emergency. Facilities established for either dedicated permanent use or on an ad hoc basis depending on the specific type and location of the operational emergency can include Emergency Operations Centers (EOCs), Command Centers, and Joint Information Centers. Departmental assets that may be required in the event of an operational emergency involving nuclear weapons, weapons components, or the dispersal of special nuclear materials include the Accident Response Group, Nuclear Emergency Search Team, Federal Radiological Monitoring and Assessment Center, Aerial Measuring System, Atmospheric Advisory Capability, Radiological Emergency Assistance Center/Training Site, and the Radiological Assistance Program.

Emergency categorization and classification. DOE Order 151.1C and the associated Emergency Management Guide (DOE G 151.1-1A) require a DOE site or facility to declare an operational emergency when unplanned or abnormal events or conditions require time-urgent response from outside the immediate affected site, facility, or area of the incident. Events or conditions meeting the criteria for categorization as operational emergencies are those events or conditions that have the potential to cause: serious health or safety impacts to workers or the public; serious detrimental effects on the environment; direct harm to people or the environment as a result of degradation of security or safeguards conditions; direct harm to people or the environment as a result of a major degradation of safety systems, protocols, or practices involving hazardous biological agents or toxins; or loss of control over hazardous materials (for example, toxic chemicals or radioactive materials). NNSA sites or facilities are also required to classify an operational emergency that involves the loss of control over hazardous materials resulting in an actual or potential airborne release to the environment (outside a structure or enclosure on an NNSA facility or site) as either an Alert, Site Area Emergency, or General Emergency, in order of increasing severity.

Notifications and communications. The accurate, timely, and useful exchange of information during an emergency response is a key factor in understanding the scope of an emergency and providing proper response to limit its impacts. Emergency reporting includes initial notifications to onsite personnel, emergency response personnel, and offsite authorities including applicable NNSA elements; other Federal Agencies; and local, state, and tribal government organizations, and follow-on emergency status updates.

Consequent assessment. Consequence assessment includes all processes utilized to perform data collection and analysis necessary to support critical initial assessments and the continuing processes of refining the assessments as more information and additional resources become available. These can involve monitoring for specific indicators or field measurements and the integration of monitoring data with calculations and modeling capabilities. Consequence assessment is integrated with both event classification and protective action decision making and can include coordination with offsite entities including federal, state, local, and tribal organizations.

Protective actions and re-entry. Protective actions can be implemented either individually or in combination to reduce exposure of the workforce and the public to special nuclear materials or other hazardous materials. These can include:

- Controlling, monitoring, and maintaining records of personnel exposure to radiological and nonradiological hazardous materials;
- Sheltering or evaluation;
- Turning off heating, ventilation, and air conditioning systems during sheltering;
- Controlling access to contaminated areas and decontaminating personnel or equipment exiting the area;
- Controlling foodstuffs and water, or changing livestock and agricultural practices; and
- Developing and deploying for use in protective action decision making prepared Protective Action Guides and Emergency Response Planning Guidelines using DOE-approved guidance applicable to the actual or potential release of hazardous materials.

Planning and executing re-entry activities must include establishing adequate measures for the protection of response personnel from unnecessary exposure to hazardous materials or conditions either known or suspected to exist at the site of the accident or incident.

Emergency medical support. Emergency medical support includes providing various levels of treatment to those who may become injured or contaminated and arranging with offsite medical facilities to transport, accept, and treat contaminated, injured personnel. DOE Order 440.1A establishes requirements for facility and site medical programs required to meet the provisions of 10 CFR 851.210, *Occupational Medicine*, and addresses the medical organization, facilities and equipment, communications planning, and preparedness activities considered necessary for providing the medical treatment and access to medical services for mass casualty situations and medical response to an operational emergency involving contamination.

Emergency public information. The Emergency Public Information program plays a critical role in establishing and maintaining coordination with tribal, state, and local governments and the public. The program is expected to provide timely, candid, and accurate information to the workforce, the news media, and the public during an operational emergency. Providing accurate and factual health and safety information and security information helps to avoid and discourage speculation. The elements of an effective program can be pre-established by developing appropriate broadcast and print media interfaces, establishing a system for assembling and releasing emergency information that may include set-up of a Joint Information Center with representatives of offsite organizations, and conducting various drills and exercises that include exercising various Emergency Public Information program systems to educate the press and the public.

Termination and recovery. An operational emergency is terminated only after a predetermined set of criteria is met and in many scenarios, termination must be coordinated with various offsite agencies. The various pathways and timelines for recovery and resumption of normal operations must be developed to ensure the health and safety of the work force and the public. Actions may include the creation of a recovery organization to manage the conduct of recovery operations and to maintain communication and coordination with local, state, and tribal organizations, and other federal agencies providing support at the site. Specific recovery procedures may include dissemination of information to federal, state, tribal, and local organizations regarding the emergency and conditions required for the relaxation of public protection measures; planning and conducting decontamination actions; development and compliance with reporting requirements; and the creation of processes and procedures to guide the resumption of normal operations. Recovery also specifically includes the evaluation of the accident or incident and the response to identify lessons learned and develop potential means to mitigate the effects of future operational emergencies.

B.12.3.3.3 Progressive Recovery Through Long-Term Response

The recovery phase of an operational emergency in which radioactive materials are dispersed over a wide area could require years to complete and might require an extended response by NNSA. The specific requirements for an extended response would be dictated by the circumstances. Requirements may include a continuing coordination with local authorities and various government agencies to continue protective actions and controls; long-term monitoring of the affected environment, population, or both for effects attributable to the operational emergency; providing medical support for affected individuals; maintaining public information and various technical and other response interfaces; and performing periodic reassessments and evaluations of progress in the recovery and return to more normal conditions.

B.13 TRANSPORTATION

B.13.1 Description of Affected Resources and Region of Influence

Transportation routes in the vicinity of the proposed Complex Transformation location have been identified, in text and on a map, to indicate which highways would be impacted by Complex Transformation traffic, including commuters and shipments. Traffic data, such as annual average daily traffic, is presented as a baseline for a subsequent qualitative analysis of increased traffic congestion. Traffic data has been derived from recent DOE environmental documentation or from state agencies.

B.13.2 Description of Impact Assessment

The Complex Transformation SPEIS assesses the impacts associated with the transportation of radiological materials and workers as described below. The methodology for both the programmatic alternatives and project-specific alternatives was the same.

B.13.2.1 *Incident-Free Transportation Impacts*

The amount of radiological material requiring transportation was first determined based on information from the Complex Transformation alternative data report [NNSA 2007]. Next, using the RADTRAN 5 code, routes and routing characteristics were determined for the origin-destination pairs associated with the transportation of radiological material.

Radiological dose during normal, incident-free transportation of radioactive materials results from exposure to the external radiation field that surrounds the shipping containers. The dose is a function of the number of people exposed, their proximity to the containers, their length of time of exposure, and the intensity of the radiation field surrounding the containers. For the purpose of providing a conservative estimate of impacts, exposure rates assumed exposure rates of five millirem per hour. This assumption is much higher than assumptions utilized in the handling/loading analysis of pits and canned subassemblies (CSAs) provided in the *Final Environmental Impact Statement for the Continued Operation of the Pantex Plant and Associated Storage of Nuclear Weapon Components*. In that FEIS, an external exposure rate of one millirem per hour was assumed (DOE 1996).

Loading operations typically represent the largest exposure impacts involved with the transportation of nuclear materials. NNSA assumed that loading operations would require one shift-day for each truck trailer loaded. A shift-day would represent a crew of five workers exposed to the load for eight hours. Estimation of loading operation impacts of other materials and waste products was based on the size and number of packages per load.

Radiological impacts were determined for crew workers and the general population during normal, incident-free transportation. For shipments, the crew was defined as the driver and passenger of the shipment vehicles. The general population was the individuals within 800 meters (2,625 feet) of the road, sharing the road, and at stops. Collective doses for the crew and general population were calculated using the RADTRAN 5.6/RadCat 2.3 computer codes (Weiner et al. 2006).

For the worker populations, DOE evaluated the following scenario:

- A truck driver and passenger, serving as an escort, that would be expected to drive radioactive shipments for 1,000 hours per year and unload shipments for 1,000 hour per year.

For shipments, the three scenarios for members of the public were:

- A person caught in traffic and located 1 meter (3 feet) away from the surface of the shipping container for 30 minutes;
- A service station worker working at a distance of 20 meters (66 feet) from the shipping container for 1 hour; and,
- A resident living 30 meters (98 feet) from the highway used to transport the shipping container.

The hypothetical maximum exposed individual doses were accumulated for all shipments over one year. For workers, it was assumed that they would be exposed to 23 percent of the shipments, based on working 2,000 hours per year. However, for the scenario involving an individual caught in traffic next to a truck, the radiological exposures were calculated for only one event because it was considered unlikely that the same individual would be caught in traffic next to all containers for all shipments. The maximum exposed transportation worker is the driver who was assumed to drive shipments for up to 1,000 hours per year. In the maximum exposed individual scenarios, the exposure rate for the shipments depended on the type of material being transported. Also, the maximum exposure rate for the truck driver was two millirem per hour (10 CFR 71.47[b] [4]).

Incident-free nonradiological fatalities were estimated using unit risk factors. These fatalities would result from exhaust and fugitive dust emissions from highway and rail traffic and are associated with 10-micrometer particles. The nonradiological unit risk factors were adopted from the transportation analysis conducted for the Final West Valley Demonstration Waste Management EIS (DOE 2003). The unit risk factors used in this analysis was 1.5×10^{-11} fatalities per kilometer per persons per square kilometer for diesel truck transport.

B.13.2.2 *Transportation Accidents*

The offsite transportation accident analysis considers the impacts of accidents during the transportation of radiological materials. Under accident conditions, impacts to human health and the environment may result from the release and dispersal of radioactive material. Accidents that could potentially breach the shipping container are represented by a spectrum of accident severities and radioactive release conditions. Historically, most transportation accidents involving radioactive materials have resulted in little or no release of radioactive material from the shipping container. Consequently, the analysis of accident risks takes into account a spectrum of accidents ranging from high-probability accidents of low severity to hypothetical high-severity accidents that have a correspondingly low probability of occurrence. This accident analysis calculates the probabilities and consequences from this spectrum of accidents.

To provide NNSA and the public with a reasonable assessment of radioactive waste transportation accident impacts, two types of analyses were performed. An accident risk assessment was performed that takes into account the probabilities and consequences of a spectrum of potential accident severities using a methodology developed by the NRC (NRC 1977; Fischer et al. 1987; Sprung et al. 2000). For the spectrum of accidents considered in the analysis, accident consequences in terms of collective dose to the population within 80 kilometers (50 miles) were multiplied by the accident probabilities to yield collective dose risk using the RADTRAN 5.6/RadCat 2.3 computer code (Weiner 2006).

The impacts for specific alternatives were calculated in units of dose (rem or person-rem). Impacts are further expressed as health risks in terms of estimated latent cancer fatalities in exposed populations. The health risk conversion factor of 0.0006 LCF/person-rem was derived from the Interagency Steering Committee on Radiation Standards report (ISCOR 2002), A Method for Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE).

The risk analyses consider a spectrum of accidents of varying severity. Each first determines the conditional probability that the accident will be of a specified severity. Then, based on the accident environment associated with each severe accident, each models the behavior of the material being shipped and the response of the packaging. The models estimate the fraction of each species of radioactive material that might be released for each of the severe accidents being considered.

B.13.2.3 *Traffic Impacts*

Traffic flow has been analyzed to determine whether or not the flow would be adversely impacted by the addition of new commuters at each of the potential sites for both construction and operations phases. The number of new commuters has been determined based on construction and operations employment. The analysis determined the percent change in traffic as a result of the alternatives.

B.14 WASTE MANAGEMENT

B.14.1 Description of Affected Resources and Region of Influence

A key goal of Complex Transformation is to develop a safe, secure, environmentally compliant facilities based on modern manufacturing procedures. Waste minimization is a goal of Complex Transformation. The production of waste requiring offsite disposal will be reduced to as low as reasonably achievable (ALARA) consistent with cost-benefit analyses. Waste minimization and pollution prevention efforts and the management of Complex Transformation-related wastes have been analyzed for each alternative site. The impact assessment addresses the projected waste types and volumes from Complex Transformation facilities and operations at each site compared to the No Action Alternative. The methodology for both the programmatic alternatives and project-specific alternatives was the same.

Wastes generated during Complex Transformation operations would consist of five primary types: transuranic (TRU) waste, low-level waste (LLW), mixed LLW, hazardous waste, and nonhazardous waste. Waste management facilities supporting Complex Transformation operations would treat and package the waste into forms that would enable long-term storage or disposal. Other waste types generated by Complex Transformation facilities would be transferred to existing facilities and managed in accordance with current practices at the DOE site.

B.14.2 Description of Impact Assessment

To provide a framework for addressing the impacts of waste management for Complex Transformation facilities, descriptive information has been presented on each site's waste management capabilities. The volumes of each waste type generated are estimated. These estimates, obtained from the Complex Transformation data call, include consideration of concepts for waste minimization. Impacts have been assessed in the context of existing site practices for treatment, storage, and disposal including the applicable regulatory requirements. Permits, compliance agreements, and other site-specific practices have been reviewed and analyzed to assess the ability to conduct the Complex Transformation-related waste management activities.

DOE generates both "routine" waste (e.g., job control, maintenance) and waste associated with Environmental Restoration (ER) and Decontamination and Decommissioning (D&D) activities. The ER/D&D waste volumes can vary greatly from year to year and often exceed the routine waste volumes. ER/D&D waste is fundamentally different (more volume, less contamination) from routine wastes and is frequently managed at separate facilities. The estimated waste volumes for Complex Transformation operations have been compared to the routine waste generation at each site to identify potential impacts to the site's waste management infrastructure.

For any alternatives that generate TRU waste, the number of additional shipments required to transport TRU waste to the Waste Isolation Pilot Plant (WIPP) was estimated and the impacts assessed as part of the transportation analysis. The SPEIS acknowledges that the total disposal capacity at WIPP is limited to 6,180,000 ft^3 under the *WIPP Land Management Act*. However, DOE continues to recognize that the amount of TRU waste to be disposed of could exceed these volumes. In the future, if inventory projects show a need for additional disposal capacity for TRU waste, DOE would initiate the development of strategies for expanding such capacity at an appropriate time. However, because DOE has made no plans to date regarding the location or design of a waste disposal facility for TRU waste beyond WIPP's current capacity, this SPEIS assumed WIPP as the disposal location for TRU waste generated under each alternative, for the purposes of transportation analysis only.

For sites under consideration for Complex Transformation that do not have existing or planned onsite LLW disposal, the number of additional shipments required to transport LLW from the site to a DOE LLW disposal facility has been estimated. For example, for purposes of this analysis, it is assumed that the Pantex Plant would ship its LLW to the Nevada Test Site (NTS) as per current practice. The risks associated with additional LLW shipments have been addressed as part of the transportation impacts assessment.

B.15 CUMULATIVE IMPACTS

The Council on Environmental Quality (CEQ) regulations implementing NEPA define cumulative effects as "the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). The regulations further explain "cumulative effects can result from individually minor but collectively significant actions taking place over a period of time." Other DOE programs and other Federal, State, and local development programs all have the potential to contribute to cumulative effects on DOE sites.

The methodology for the analysis of cumulative effects for the Complex Transformation SPEIS was developed from the guidelines and methodology in the CEQ's *Considering Cumulative Effects Under the National Environmental Policy Act*. The major components of the CEQ methodology include:

- Scoping, including identifying the significant potential cumulative effects issues associated with the proposed action, and identifying other actions affecting the resources;
- Describing the affected environment; and
- Determining the environmental consequences, including the impacts from the proposed action and other activities in the ROI, and the magnitude and significance of the cumulative effects

The cumulative effects of the Complex Transformation SPEIS alternatives have been analyzed for each alternative site by reviewing and analyzing data from existing NEPA documents and other DOE documents. To update the data and to supplement this information, Internet searches, literature reviews of environmental documents for the regions surrounding the proposed sites, and personal contacts with local government planning departments have been undertaken, as needed, to obtain information on the potential cumulative effects for each resource area. For some resource areas, the analysis includes the cumulative regional impacts. For example, the air analysis must examine air quality in the region for each potential site in order to access the impacts of the proposed action.

Environmental impacts for other DOE programs and other Federal, State, and local development programs for each potential site have been reviewed and the cumulative impacts analyzed. The analysis includes impacts from previous actions at each of the sites and within the region of influence, current actions, and actions planned for reasonably foreseeable future actions. These impacts, combined with the impacts from the Complex Transformation SPEIS, form the basis of the analysis of cumulative effects. Where possible, quantifiable data is used. The level of analysis for each resource area is commensurate to the importance of the potential cumulative impacts on that resource. The data and analysis are then summarized and potential cumulative impacts for each site identified. For the project-specific analyses, because impacts were generally very small relative to existing operations at sites, the analysis of the additive project-specific impacts to the site baseline was tantamount to a cumulative assessment.